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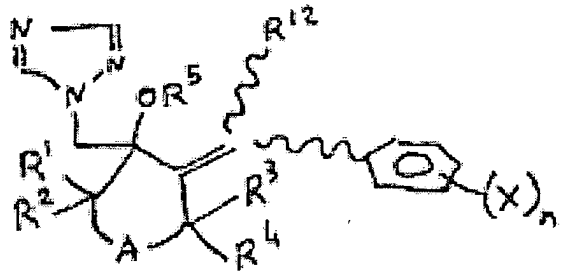
(54) Process for improving vigor and/or health of plants such as cereals by treatment with a triazole derivative

(57) Process for improving the health and vigor of plants, characterized in that before sowing, the seed grains [¹] are treated with a triazole of formula (I).

The reproductive materials of plants coated with the composition according to the invention, and this composition.



(I)

EP 0 622 020 A1

This invention relates to a process for improving the vigor of plants, independently of diseases with which they could be infected.

European Patent Application 378953 describes the curative or preventive treatment of plants for fungal diseases by applying an active substance based on certain triazoles to said reproductive material.

European Patent Application 467791 describes the curative or preventive treatment of reproductive materials of plants and the plants resulting therefrom for fungal diseases by applying to said reproductive material a fungicidal composition containing 2-(4-chlorobenzylidene)-5,5-dimethyl-1-(1H-1,2,4-triazol-1-ylmethyl)-1-cyclopentanol, an agriculturally acceptable inert vehicle, and optionally an agriculturally acceptable surfactant.

As already indicated, the present invention relates more particularly to a process with the aim of improving the vigor and/or the health of plants, especially cereals, independently of diseases with which they could be infected or which might infect them in future. More precisely, the aim of the invention is a process:

* to improve the health of the plants, and/or
* to contribute to plant stem shortening, and/or
* to promote their resistance to lodging (even when eyespot disease is not present), and/or
* to increase nitrogen absorbed by the plants from the soil, and/or
* to decrease the amount of nitrogen that must be applied to the crop as fertilizer or manure.

The invention further relates to an agrochemical composition intended to improve the vigor and health of plants, especially cereals, independently of diseases with which they could be infected or which might infect them in future, as specified by one or more aspects of the aforementioned aims. In other words, this invention relates to agrochemical compositions intended:

* to improve the health of the plants, and/or
* to contribute to plant stem shortening, and/or
* to promote their resistance to lodging (even when eyespot disease is not present), and/or
* to increase nitrogen absorbed by the plants from the soil, and/or
* to decrease the amount of nitrogen that must be applied to the crop as fertilizer or manure.

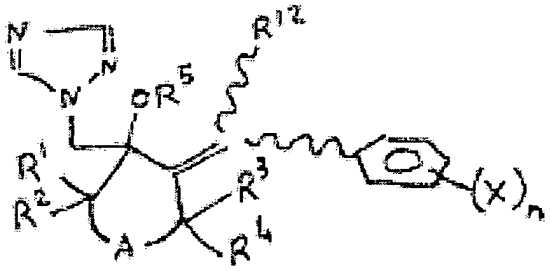
Finally, the invention relates to reproductive material intended to generate plants (especially cereals) with improved vigor and health, independently of diseases with which they could be infected or which might infect them in future, where these reproductive materials are characterized in that they are capable of generating plants that:

* have improved health, and/or
* have a shortened stem under certain conditions, and/or
* have improved resistance to lodging (even when eyespot disease is not present), and/or
* have increased nitrogen absorbed by the plants from the soil, and/or

* require less nitrogen that must be applied to the crop as fertilizer or manure.

It has been found that these aims can be achieved as a result of treatment according to the invention. This treatment is a treatment characterized in that it has the aforementioned aims and that it consists of treating grains or seeds before sowing with an effective amount of a triazole of formula (I) below:

(I)



in which

A is $-CR_6R_7-$ or $-CR_6R_7-CR_8R_9-$ or $-CR_6R_7-CR_8R_9/CR_{10}R_{11}-$

X is a halogen atom, preferably fluorine, bromine, chlorine, or a cyano or nitro group,

or a C_1-C_4 alkyl or C_1-C_4 alkoxy group, optionally halogenated,

n is zero or a positive integer less than 6, where the X groups can be the same or different when *n* is greater than 1,

R_1, R_2, the same or different, represent the hydrogen atom or a C_1-C_4 alkyl group that is optionally substituted (for example, by one or more atoms or groups such as halogen atoms, C_1-C_4 alkoxy, monohalogenated or polyhalogenated C_1-C_4 alkoxy, C_2-C_4 alkenyl, C_2-C_4 alkynyl, monohalogenated or polyhalogenated C_2-C_4 alkenyl, monohalogenated or polyhalogenated C_2-C_4 alkynyl groups), a C_1-C_4 alkoxy group that is optionally substituted (for example, by one or more atoms or groups such as halogen atoms, C_1-C_4 alkoxy, monohalogenated or polyhalogenated C_1-C_4 alkoxy, C_2-C_4 alkenyl, C_2-C_4 alkynyl, monohalogenated or polyhalogenated C_2-C_4 alkenyl, monohalogenated or polyhalogenated C_2-C_4 alkynyl groups), C_3-C_7 cycloalkyl, C_6-C_{10} aryl (in particular phenyl), C_7-C_{11} aralkyl (in particular benzyl) groups, where these various groups can be optionally substituted (for example, by one or more atoms or groups such as halogen atoms, C_1-C_4 alkyl groups, monohalogenated or polyhalogenated C_1-C_4 alkyl groups, C_1-C_4 alkoxy groups,[2] and monohalogenated or polyhalogenated C_1-C_4 alkoxy groups), R_1, R_2 together can make a C_2-C_5 hydrocarbon chain forming a ring with the carbon to which R_1, R_2 are linked, where this chain is optionally substituted as for the C_6-C_{10} aryl groups indicated above, or R_1, R_2 together can make a dioxolane C_2-C_5 hydrocarbon chain with the carbon to which R_1, R_2 are linked, where this chain is optionally substituted as for the C_6-C_{10} aryl groups indicated above.

R_3, R_6 to R_{11}, the same or different, represent the hydrogen atom or a C_1-C_4 alkyl group that is optionally substituted (for example, by one or more atoms or groups such as halogen atoms, C_1-C_4 alkoxy, monohalogenated or polyhalogenated C_1-C_4 alkoxy groups), C_3-C_7 cycloalkyl, C_6-C_{10} aryl (in particular phenyl), C_7-C_{11} aralkyl (in particular benzyl) groups, where these various groups can be optionally substituted (for example, by one or more atoms or groups such as halogen atoms, C_1-C_4 alkyl groups monohalogenated or polyhalogenated C_1-C_4 alkyl groups, C_1-C_4 alkoxy groups, and monohalogenated or polyhalogenated C_1-C_4 alkoxy groups), or else two groups adjacent to chain A, together with the atoms of A to which they are attached, form a phenyl ring fused to the cycloalkane,

R_5 represents the hydrogen atom, a C_1-C_4 alkyl group that is optionally substituted (for example, by one or more atoms or groups such as halogen atoms, C_1-C_4 alkoxy, monohalogenated or polyhalogenated C_1-C_4 alkoxy, C_2-C_4 alkenyl, C_2-C_4 alkynyl, monohalogenated or polyhalogenated C_2-C_4 alkenyl, monohalogenated or polyhalogenated C_2-C_4 alkynyl groups), C_3-C_7 cycloalkyl, C_6-C_{10} aryl (in particular phenyl), C_7-C_{11} alkyl [sic, should be aralkyl] (in particular benzyl) groups, where these various groups can be optionally substituted (for example, by one or more atoms or groups such as halogen atoms, C_1-C_4 alkyl groups, monohalogenated or polyhalogenated C_1-C_4 alkyl groups, C_1-C_4 alkoxy groups, [3] and monohalogenated or polyhalogenated C_1-C_4 alkoxy groups), or R_5 represents a C(=O)-R_{13} group, where R_{13} represents a C_1-C_4 alkyl group that is optionally substituted (for example, by one or more atoms or groups such as halogen atoms, C_1-C_4 alkoxy, monohalogenated or polyhalogenated C_1-C_4 alkoxy, C_2-C_4 alkenyl, C_2-C_4 alkynyl, monohalogenated or polyhalogenated C_2-C_4 alkenyl, monohalogenated or

polyhalogenated C_2-C_4 alkynyl groups), C_3-C_7 cycloalkyl, C_6-C_{10} aryl (in particular phenyl), C_7-C_{11} aralkyl (in particular benzyl) groups, where these various groups can be optionally substituted (for example, by one or more atoms or groups such as halogen atoms, C_1-C_4 alkyl groups, monohalogenated or polyhalogenated C_1-C_4 alkyl groups, C_1-C_4 alkoxy groups, and monohalogenated or polyhalogenated C_1-C_4 alkoxy groups), a C_2-C_4 alkenyl, C_2-C_4 alkynyl, monohalogenated or polyhalogenated C_2-C_4 alkenyl, monohalogenated or polyhalogenated C_2-C_4 alkynyl,

R_{12} has one of the meanings of R_5, except for C(=O)-R_{13},

R_4 represents the hydrogen atom, a halogen atom, in particular a chlorine or bromine atom, a C_1-C_4 alkyl group that is optionally substituted (for example, by one or more atoms or groups such as halogen atoms, C_1-C_4 alkoxy, monohalogenated or polyhalogenated C_1-C_4 alkoxy, C_2-C_4 alkenyl, C_2-C_4 alkynyl, monohalogenated or polyhalogenated C_2-C_4 alkenyl, monohalogenated or polyhalogenated C_2-C_4 alkynyl groups), C_3-C_7 cycloalkyl, C_6-C_{10} aryl (in particular phenyl), C_7-C_{11} alkyl [sic, should be aralkyl] (in particular benzyl) groups, where these various groups can be optionally substituted (for example, by one or more atoms or groups such as halogen atoms, C_1-C_4 alkyl groups, monohalogenated or polyhalogenated C_1-C_4 alkyl groups, C_1-C_4 alkoxy groups, and monohalogenated or polyhalogenated C_1-C_4 alkoxy groups).

The invention also relates to use of the salts of compounds of formula (I). The salts are agriculturally acceptable forms, among which we may mention: the hydrochloride, sulfate, oxalate, nitrate, or arylsulfonate as well as addition complexes of these compounds with metal salts, and in particular iron, chromium, copper, manganese, zinc, cobalt, tin, magnesium, and aluminum salts.

Within this text, unless otherwise indicated, the relevant groups can be branched or linear. The term "optionally halogenated" means optionally monohalogenated or polyhalogenated.

The compounds of formula I can exist in one or more isomeric forms depending on the number of asymmetric centers in the molecule. The invention therefore relates to use of all the optical isomers [as well as] [4] their racemic mixtures and corresponding diastereoisomers. The diastereoisomers and/or the optical isomers can be separated by known methods.

In formula (I), the symbol  means that the stereochemistry of the double bond can be either *E* or *Z* or a mixture of both. Considering the steric constraints, the major form will be the form where R_{12} is in the *E* position relative to R_3, R_4. The *E* portion is practically the only form obtained when R_{12} is H.

The preferred compounds used in the invention include compounds with a formula satisfying one or more of the following conditions:

* *n* = 1 or 2, and X is a halogen atom in the *para* position when *n* = 1 and in *meta/para* or *ortho/para* positions when *n* = 2, and/or
* *n* = 1 and X is in the *para* position, and/or
* X is a chlorine atom, and/or
* $R_3 = R_6 = R_8 = R_{10}$ = hydrogen atom, and/or alkyl, and/or
* $R_4 = R_7 = R_9 = R_{11}$ = hydrogen atom or a C_1-C_4 alkyl group, and/or
* R_1 and R_2 are selected from among methyl, ethyl groups or a hydrogen atom, and/or
* R_5 is the hydrogen atom or C_1-C_4 [5] alkyl, R_5 is very advantageously the hydrogen atom, and/or
* R_{12} is the hydrogen atom, and/or
* A is CR_6R_7 or $-CR_6R_7CR_8R_9$, and/or
* A is CR_6R_7; R_1, R_2 are selected from among methyl or ethyl groups; R_3, R_5 to R_7, R_{12} are the hydrogen atom; R_4 is methyl, ethyl, *n*-propyl, *i*-propyl, or the hydrogen atom, and/or
* A is CR_6R_7, CR_8R_9; R_1, R_2 are selected from among methyl, ethyl groups or the hydrogen atom; R_3, R_5 to R_9, R_{12} are the hydrogen atom; R_4 is methyl, ethyl, *n*-propyl, *i*-propyl, or the hydrogen atom.

The following compounds are preferred:

* 2-(4-chlorobenzylidene)-5-methyl-5-ethyl-1-(1H-1,2,4-triazol-1-ylmethyl)-1-cyclopentanol
* 2-(4-chlorobenzylidene)-6-methyl-1-(1H-1,2,4-triazol-1-ylmethyl)-1-cyclopentanol
* 2-(4-chlorobenzylidene)-6,6-dimethyl-1-(1H-1,2,4-triazol-1-ylmethyl)-1-cyclohexanol.
* 2-(4-chlorobenzylidene)-1-(1H-1,2,4-triazol-1-ylmethyl)-1-cyclohexanol, and/or

  and [sic] more particularly the compound 2-(4-chlorobenzylidene)-5,5-dimethyl-1-(1H-1,2,4-triazol-1-ylmethyl)-1-cyclopentanol.

The term "reproductive material" is understood to mean any generative parts of the plant that can be used for reproduction of the plant. For example, we might mention grains (seeds in the narrow sense of the word), roots, fruits, tubers, bulbs, rhizomes, parts of plants. We might also mention germinated plants and young plants which should be transplanted after germination or after emergence from the

soil. These young plants can be protected before transplanting by total or partial treatment by immersion.

Seed grains are preferred for crops other than potatoes. Among the reproductive materials suitable for the treatment process according to the invention, the following are preferred:

* seed grains of dicotyledons: peas, cucumbers, melons, soy, cotton, sunflowers, rape, beans, flax, beets
* seed grains of monocotyledons: cereals (wheat, except for the Talent variety before tillering begins, barley, rye, oats), corn, rice
* or potato tubers.

The grains are preferably coated with 0.1 g to 500 g of active substance per quintal [^{6}] of grain, preferably 1 g to 400 g per quintal.

Tubers are preferably coated with a quantity of active substance corresponding to soaking said material in a composition containing 0.1 g/L to 100 g/L of active substance.

Another object of the invention is use of the triazole of formula (I) according to the invention to make agrochemical compositions intended:

* to improve the health of the plants, and/or
* to contribute to plant stem shortening, and/or
* to promote their resistance to lodging (even when eyespot disease is not present), and/or
* to increase nitrogen absorbed by the plants from the soil, and/or
* to decrease the amount of nitrogen that must be applied to the crop as fertilizer or manure.

Another object of the invention is use of the triazole of formula (I) according to the invention to obtain plant reproductive materials capable of generating plants that:

* have improved health, and/or
* have a shortened stem under certain conditions, and/or
* have improved resistance to lodging (even when eyespot disease is not present), and/or
* have increased nitrogen absorbed by the plants from the soil, and/or
* require less nitrogen that must be applied to the crop as fertilizer or manure.

The compositions according to the invention usually contain between 0.5% and 95% active substance. The rest of the ingredients to make up 100% consist of a vehicle and optionally various additives such as indicated below.

In this text, the term "vehicle" means an organic or inorganic, natural or synthetic material with which the active substance is combined to facilitate its application to the plant, the grains, or the soil. This vehicle is therefore generally inert and should be agriculturally acceptable, in particular for the treated plant. The vehicle can be solid (clays, natural or synthetic silicates, silica, resins, waxes, solid fertilizers, etc.) or liquid (water, alcohols, ketones, petroleum fractions, aromatic or paraffin hydrocarbons, chlorinated hydrocarbons, liquefied gases, etc.)

The surfactant can be an emulsifier, dispersing agent, or wetting agent of the ionic or nonionic type. For example, we may mention salts of polyacrylic acids, salts of lignosulfonic acids, salts of phenolsulfonic or naphthalenesulfonic acids, polycondensates of ethylene oxide with fatty alcohols or fatty acids or fatty amines, substituted phenols (in particular alkylphenols or arylphenols), salts of sulfosuccinic acid esters, taurine derivatives (in particular alkyltaurates), phosphoric esters of alcohols or polyoxyethylated phenols. The presence of at least one surfactant is often required because the active substance and/or the inert vehicle are not soluble in water and the carrier for application is water.

This composition can also contain any type of other ingredients such as, for example, protective colloids, adhesives, thickeners, thixotropic agents, penetration agents, stabilizers, sequestrants, pigments, dyes, polymers.

More generally, the compositions according to the invention can be combined with any solid or liquid additives corresponding to conventional formulation techniques for application of the seed treatment in particular.

In this connection, we note that in the vocabulary of persons skilled in the art, the term "seed treatment" in fact refers to treatment of grains.

Application techniques are well known to the person skilled in the art, and they can be conveniently used within the present invention.

For example, we may mention film-coating or coating.

Among the compositions, we may generally mention solid or liquid compositions.

As solid composition forms, we may mention powders for dusting or dispersing (the content of the compound of formula (I) can be as high as 100%) and granules, in particular those obtained by extrusion, compaction, impregnation of a granulated vehicle, granulation from a powder (the content of the compound of formula (I) in these granules is between 1% and 80% for the latter cases).

The compositions can also be used in the form of a powder for dusting; a composition can thus be used that contains 50 g of active substance, 10 g of finely divided silica, 10 g of organic pigment, and 970 g of talc; these constituents are mixed and ground, and the mixture is applied by dusting.

As liquid composition forms or forms intended to make up liquid compositions at the time of application, we may mention solutions, in particular water-soluble concentrates, emulsifiable concentrates, emulsions, concentrated suspensions, aerosols, wettable powders (or powder to be sprayed), pastes, dispersible granules.

The emulsifiable or soluble concentrates most often include 10% to 80% active substance; the ready-to-use emulsions or solutions contain 0.01% to 20% active substance.

For example, in addition to the solvent, the emulsifiable concentrates can contain if necessary 2% to 20% of appropriate additives such as the stabilizers, surfactants, penetration agents, corrosion inhibitors, dyes, or adhesives indicated above.

Emulsions of any desired concentration which are particularly suitable for application to seeds can be obtained from these concentrates by dilution with water.

The concentrated suspensions, which can also be used for spraying, are prepared in such a way that a stable fluid product is obtained that does not settle out, and they usually contain from 1% to 75% active substance (preferably from 2% to 50%), from 0.5% to 15% surfactants, from 0.1% to 10% thixotropic agents,

from 0% to 10% of appropriate additives such as pigments, dyes, antifoaming agents, corrosion inhibitors, stabilizers, penetration agents, and adhesives, and as the vehicle, water or an organic liquid in which the active substance is poorly soluble or insoluble: some solid organic materials or inorganic salts can be dissolved in the vehicle to help prevent sedimentation or as antifreeze for the water.

Wettable powders (or powder to be sprayed) are usually prepared in such a way that they contain 1% to 95% active substance (preferably from 2% to 80%), and they usually contain, in addition to the solid vehicle, from 0% to 5% of a wetting agent, from 3% to 10% of a dispersing agent, and if necessary from 0% to 10% of one or more stabilizers and/or other additives such as pigments, dyes, penetration agents, adhesives, or anticaking agents, dyes, etc.

In order to obtain these powders to be sprayed or wettable powders, the active substance is intimately mixed in appropriate mixers with the additional substances, and ground with mills or other appropriate grinders. In this way, powders to be sprayed are obtained with advantageous wettability and suspension; they can be suspended with water at any desired concentration, and these suspensions can be used very advantageously for application to seeds in particular.

Pastes can be prepared instead of wettable powders. The conditions and methods for preparing and using these pastes are similar to those for wettable powders or powders to be sprayed.

The dispersible granules are usually prepared by agglomeration of compositions of the wettable powder type in appropriate granulation systems.

As already indicated, the aqueous dispersions and emulsions, for example the compositions obtained by diluting a wettable powder or an emulsifiable concentrate according to the invention with water, are included within the general scope of this invention. The emulsions can be of the water-in-oil or oil-in-water type, and they can have a thick, mayonnaise-like consistency.

Among these compositions, the person skilled in the art may advantageously choose the composition(s) suitable for the conditions of use.

Another object of the invention is the reproductive material of plants with the preferred variants such as have been defined above, coated with and/or containing 2-(4-chlorobenzylidene)-5,5-dimethyl-1-(1H-1,2,4-triazol-1-ylmethyl)-1-cyclopentanol, hereinafter called triticonazole.

The term "coated with and/or containing" means that the active substance is found mainly at the surface of the material during application, although a more or less significant portion may penetrate depending on the application method. When said reproductive material is replanted, it absorbs the active substance.

The reproductive material is preferably selected from among the seed grains, advantageously selected from among the grains [of]:

* dicotyledons: peas, cucumbers, melons, soy, cotton, sunflowers, rape, beans, flax, beets
* monocotyledons: soft winter wheat except for the Talent variety, soft spring wheat, hard wheat, barley, rye, oats, alfalfa, corn, rice.

The grains are preferably coated with 0.1 g to 500 g of active material per quintal of grain, and preferably 1 g to 400 g/quintal.

In another advantageous variant, the reproductive material is a potato tuber preferably coated with an amount of active substance corresponding to soaking said material in a solution containing 0.1 g/L to 100 g/L active substance.

The composition accomplishing these aims according to the invention is preferably characterized in that the reproductive materials are seed grains selected from among grains of:

* dicotyledons: peas, cucumbers, melons, soy, cotton, sunflowers, rape, beans, flax, beets
* monocotyledons: soft winter wheat except for the Talent wheat variety, soft spring wheat, hard wheat, barley, rye, oats, alfalfa, corn, rice.

The composition accomplishing the aims according to the invention is preferably characterized in that it contains 0.5% to 95% of active substance.

The following examples, provided as non-limiting, illustrate the invention and show how it can be used.

EXAMPLE 1

Soft winter wheat seeds were treated with 120 grams triticonazole per quintal of wheat seed.

In order to carry out the treatment, a concentrated suspension was used that contained 200 g/L triticonazole and 84 g/L bird repellent. This suspension was diluted with the same volume of water, and this diluted mixture was sprayed on the wheat seeds before sowing.

Sowing was done in Fall (the beginning of November). The soil contained 109 kg/ha nitrogen and 100 kg/ha was added as manure (half in April when the head with stem was one centimeter long, and the other half in May in the "2nd node" growth stage).

The cultivation conditions were conditions with no fungal infestation or with no fungal disease, where the control was protected by guazatine (80 g/quintal) and by subsequent antifungal treatments known to not have any effect of the type observed below with triticonazole.

It was observed that at flowering, the biomass of the aerial parts of the wheat plants (expressed as dry matter) represented 9820 kg/ha for plants grown from triticonazole treated grains and 8950 kg/ha for those grown from seed not treated with triticonazole.

This increased biomass with triticonazole treatment shows that the plants are much more vigorous and are healthier.

In addition, the nitrogen content of the biomass dry matter was 1.7% for plants grown from triticonazole treated seeds and 1.6% for plants grown from seeds not treated with triticonazole. This shows that triticonazole makes the plants better able to absorb nitrogen from the soil, and therefore makes it possible to reduce the amounts of nitrogen applied as fertilizer.

Finally, for plants grown from triticonazole treated seeds, the following was obtained at harvest:

* 83.1 quintals of grains per hectare,
* 150 kg/ha of nitrogen supplied by the grains
* 14330 kg/ha of biomass dry matter (straw that can be used for animals + grains).

In contrast, [for] the plants not grown from triticonazole treated seeds, the following was obtained:

* 80.4 quintals of grains per hectare,
* 142 kg/ha of nitrogen supplied by the grains
* 13730 kg/ha of biomass dry matter (straw that can be used for animals + grains).

EXAMPLE 2

Example 1 was duplicated, adding 60 kg/ha nitrogen as manure on each of the following dates: February (end of Winter), April when the head with stem was one centimeter long, and May in the "2nd node" growth stage.[7]

At flowering, biomass (dry matter) of 10610 kg/ha was observed with nitrogen content 1.8%, instead of 10010 kg/ha and 1.7% for the control from plants not treated with triticonazole.

For plants grown from triticonazole treated seeds, the following was obtained at harvest:

* 83.3 quintals of grains per hectare,
* 164 kg/ha of nitrogen supplied by the grains
* 15200 kg/ha of biomass dry matter (straw + grains).

For the control, from plants not treated with triticonazole, the following was obtained:

* 74.7 quintals of grains per hectare,

* 148 kg/ha of nitrogen supplied by the grains
* 14120 kg/ha of biomass dry matter (straw + grains).

The declared and desired effects on plant vigor, health, and reduced nitrogen requirement have thus been demonstrated.

EXAMPLE 3

Soft winter wheat seeds were treated with 120 grams triticonazole per quintal of wheat seed.

In order to carry out the treatment, a concentrated suspension was used that contained 200 g/L triticonazole and 84 g/L bird repellent. This suspension was diluted with the same volume of water, and this diluted mixture was sprayed on the wheat seeds before sowing.

Sowing was done in Fall (the beginning of November). The soil contained 50 kg/ha nitrogen and no nitrogen was added as manure or fertilizer.

The cultivation conditions were conditions with no fungal infestation or with no fungal disease, where the control was protected by copper oxinate and by subsequent antifungal treatments known to not have any effect of the type observed below with triticonazole.

The nitrogen content (in milligrams per foot of plant) was measured for roots + leaves together at the beginning of July, i.e., when the wheat began to ripen (1 month before harvest).

This content was 265 mg per foot, versus 123 mg/foot for plants not grown from triticonazole treated grains.

EXAMPLE 4

Wheat sown in Fall (end of October) was cultivated. One portion of the grains was pretreated with triticonazole (120 grams per quintal of seed), while the other portion was the control that was not treated with triticonazole.

One portion of the plants was treated with cycocel (1140 g/ha) under normal conditions, i.e., in the end of tillering/beginning of stem elongation stage. Cycocel or 3C is known to be a stem shortening agent, where this shortening is desired in order to avoid lodging due to atmospheric phenomena, while this product has no effect on eyespot. Cultivation occurred under conditions of no fungal infestation/no fungal disease.

The plant heights were recorded in the ripening stage (end of June).

While the controls that were not treated with either triticonazole or cycocel were 80 cm high, the plants treated with cycocel but not grown from triticonazole treated grains were 69 cm high, and the plants treated with cycocel and grown from triticonazole treated grains were 64 cm high.

This trial thus shows a clear synergistic effect between triticonazole and subsequent cycocel treatments, as well as shortening accentuated by use of triticonazole, which gives the plant better resistance to external stresses.

EXAMPLE 5

Wheat sown in Fall (end of October) was cultivated. One portion of the grains was pretreated with triticonazole (120 grams per quintal of seed), while the other portion was the control that was not treated with triticonazole.

One portion of the plants was treated with cycocel (1140 g/ha) under normal conditions, i.e., in the end of tillering/beginning of stem elongation stage. Cultivation occurred under conditions of no fungal infestation/no fungal disease.

One portion of the plants was treated with Ethephon alone (240 g/ha) at the beginning of the month of May. Cultivation occurred under conditions of no fungal infestation/no fungal disease.

One portion of the plants was treated in mid-April with a mixture of Ethephon 375 g/ha and cycocel 750 g/ha. Cultivation occurred under conditions of no fungal infestation/no fungal disease.

At the end of April and from May 20th to June 13th there were heavy rains. The results were measured from the percentage of the crop area where lodging occurred. The following results were obtained.

Treatment conditions	% area where lodging occurred
Untreated control	75
Plants grown from triticonazole treated grains	50
Plants grown from triticonazole treated grains and treated with cycocel	1
Plants grown from triticonazole treated grains and treated with Ethephon	9
Plants grown from triticonazole treated grains and	0

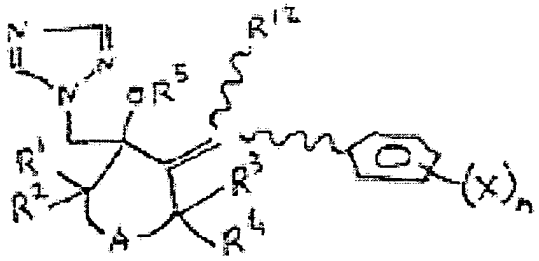
treated with Ethephon and cycocel	

Plants treated with Ethephon and cycocel but not grown from triticonazole treated grains	8
Plants treated with Ethephon alone but not grown from triticonazole treated grains	38
Plants treated with cycocel alone but not grown from triticonazole treated grains	13

This trial again shows a clear synergistic effect between triticonazole and subsequent cycocel or Ethephon treatments, as well as shortening accentuated by use of triticonazole, which gives the plant better resistance to external stresses.

Claims

1 Process to improve the vigor and/or health of plants, in particular cereals, characterized in that an effective amount of a triazole of formula (I) is applied to the seed grain before sowing,



in which

A is $-CR_6R_7-$ or $-CR_6R_7-CR_8R_9-$ or $-CR_6R_7-CR_8R_9-CR_{10}R_{11}-$

X is a halogen atom, preferably fluorine, bromine, chlorine, or a cyano or nitro group, or a C_1-C_4 alkyl or C_1-C_4 alkoxy group, optionally halogenated,

n is zero or a positive integer less than 6, where the X groups can be the same or different when *n* is greater than 1,

R_1, R_2, the same or different, represent the hydrogen atom or a C_1-C_4 alkyl group that is optionally substituted (for example, by one or more atoms or groups such as halogen atoms, C_1-C_4 alkoxy, monohalogenated or polyhalogenated C_1-C_4 alkoxy, C_2-C_4 alkenyl, C_2-C_4 alkynyl, monohalogenated or polyhalogenated C_2-C_4 alkenyl, monohalogenated or polyhalogenated C_2-C_4 alkynyl groups), a C_1-C_4 alkoxy group that is optionally substituted (for example, by one or more atoms or groups such as halogen atoms, C_1-C_4 alkoxy, monohalogenated or polyhalogenated C_1-C_4 alkoxy, C_2-C_4 alkenyl, C_2-C_4 alkynyl, monohalogenated or polyhalogenated C_2-C_4 alkenyl, monohalogenated or polyhalogenated C_2-C_4 alkynyl groups), C_3-C_7 cycloalkyl, C_6-C_{10} aryl (in particular phenyl), C_7-C_{11} aralkyl (in particular benzyl) groups, where these various groups can be optionally substituted (for example, by one or more atoms or groups such as halogen atoms, C_1-C_4 alkyl groups, monohalogenated or polyhalogenated C_1-C_4 alkyl groups, C_1-C_4 alkoxy groups,[8] and monohalogenated or polyhalogenated C_1-C_4 alkoxy groups), R_1, R_2 together can

make a C_2-C_5 hydrocarbon chain forming a ring with the carbon to which R_1, R_2 are linked, where this chain is optionally substituted as for the C_6-C_{10} aryl groups indicated above, or R_1, R_2 together can make a dioxolane C_2-C_5 hydrocarbon chain with the carbon to which R_1, R_2 are linked, where this chain is optionally substituted as for the C_6-C_{10} aryl groups indicated above.

R_3, R_6 to R_{11}, [9] the same or different, represent the hydrogen atom or a C_1-C_4 alkyl group that is optionally

substituted (for example, by one or more atoms or groups such as halogen atoms, C_1-C_4 alkoxy, monohalogenated or polyhalogenated C_1-C_4 alkoxy groups), C_3-C_7 cycloalkyl, C_6-C_{10} aryl (in particular phenyl), C_7-C_{11} aralkyl (in particular benzyl) groups, where these various groups can be optionally substituted (for example, by one or more atoms or groups such as halogen atoms, C_1-C_4 alkyl groups, monohalogenated or polyhalogenated C_1-C_4 alkyl groups, C_1-C_4 alkoxy groups, and monohalogenated or polyhalogenated C_1-C_4 alkoxy groups), or else two groups adjacent to chain A, together with the atoms of A to which they are attached, form a phenyl ring fused to the cycloalkane,

R_5 represents the hydrogen atom, a C_1-C_4 alkyl group that is optionally substituted (for example, by one or more atoms or groups such as halogen atoms, C_1-C_4 alkoxy, monohalogenated or polyhalogenated C_1-C_4 alkoxy, C_2-C_4 alkenyl, C_2-C_4 alkynyl, monohalogenated or polyhalogenated C_2-C_4 alkenyl, monohalogenated or polyhalogenated C_2-C_4 alkynyl groups), C_3-C_7 cycloalkyl, C_6-C_{10} aryl (in particular phenyl), C_7-C_{11} aralkyl (in particular benzyl) groups, where these various groups can be optionally substituted (for example, by one or more atoms or groups such as halogen atoms, C_1-C_4 alkyl groups, monohalogenated or polyhalogenated C_1-C_4 alkyl groups, C_1-C_4 alkoxy groups,[10] and monohalogenated or polyhalogenated C_1-C_4 alkoxy groups), or R_5 represents a C(=O)-R_{13} group, where R_{13} represents a C_1-C_4 alkyl group that is optionally substituted (for example, by one or more atoms or groups such as halogen atoms, C_1-C_4 alkoxy, monohalogenated or polyhalogenated C_1-C_4 alkoxy, C_2-C_4 alkenyl, C_2-C_4 alkynyl, monohalogenated or polyhalogenated C_2-C_4 alkenyl, monohalogenated or polyhalogenated C_2-C_4 alkynyl groups), C_3-C_7 cycloalkyl, C_6-C_{10} aryl (in particular phenyl), C_7-C_{11} aralkyl (in particular benzyl) groups, where these various groups can be optionally substituted (for example, by one or more atoms or groups such as halogen atoms, C_1-C_4 alkyl groups, monohalogenated or polyhalogenated C_1-C_4 alkyl groups, C_1-C_4 alkoxy groups, and monohalogenated or polyhalogenated C_1-C_4 alkoxy groups), a C_2-C_4 alkenyl, C_2-C_4 alkynyl, monohalogenated or polyhalogenated C_2-C_4 alkenyl, monohalogenated or polyhalogenated C_2-C_4 alkynyl,

R_{12} has one of the meanings of R_5, except for C(=O)-R_{13},

R_4 represents the hydrogen atom, a halogen atom, in particular a chlorine or bromine atom, a C_1-C_4 alkyl group that is optionally substituted (for example, by one or more atoms or groups such as halogen atoms, C_1-C_4 alkoxy, monohalogenated or polyhalogenated C_1-C_4 alkoxy, C_2-C_4 alkenyl, C_2-C_4 alkynyl, monohalogenated or polyhalogenated C_2-C_4 alkenyl, monohalogenated or polyhalogenated C_2-C_4 alkynyl groups), C_3-C_7 cycloalkyl, C_6-C_{10} aryl (in particular phenyl), C_7-C_{11} aralkyl (in particular benzyl) groups, where these various groups can be optionally substituted (for example, by one or more atoms or groups such as halogen atoms, C_1-C_4 alkyl groups, monohalogenated or polyhalogenated C_1-C_4 alkyl groups, C_1-C_4 alkoxy groups, and monohalogenated or polyhalogenated C_1-C_4 alkoxy groups), as well as salts of the above indicated compounds.

2 Process as in Claim 1, characterized in that [11] the application is done in the absence of fungal disease with which these grains or plants could be infected or which might infect them in future.

3 Process as in Claim 1 or Claim 2, characterized in that it has the aim of increasing the nitrogen absorbed by the plants from the soil.

4 Process as in any one of Claims 1 to 3, characterized in that it has the aim of reducing the amount of nitrogen that must be applied to the crop as fertilizer or manure.

5 Process as in any one of Claims 1 to 4, characterized in that it has the aim of contributing to plant stem shortening and/or promoting their resistance to lodging (even when eyespot disease is not present).

6 Process as in Claim 5, characterized in that the plants grown from grains treated with a triazole are subsequently treated with cycocel or Ethephon.

7 Process as in any one of Claims 1 to 8, characterized in that the triazole used has a formula in which one or more of the following conditions are satisfied:

* n = 1 or 2, and X is a halogen atom in the *para* position when n = 1 and in *meta/para* or *ortho/para* positions when n = 2, and/or
* n = 1 and X is in the *para* position, and/or
* X is a chlorine atom, and/or
* $R_3 = R_6 = R_8 = R_{10}$ = hydrogen atom, and/or
* $R_4 = R_7 = R_9 = R_{11}$ = hydrogen atom or a C_1-C_4 alkyl group, and/or
* R_1 and R_2 are selected from among methyl, ethyl groups or a hydrogen atom, and/or
* R_5 is the hydrogen atom or C_1-C_4 alkyl, R_5 is very advantageously the hydrogen atom, and/or
* R_{12} is the hydrogen atom, and/or
* A is CR_6R_7 or $-CR_6R_7CR_8R_9$, and/or
* A is CR_6R_7; R_1, R_2 are selected from among methyl or ethyl groups; R_3, R_5 to R_7, R_{12} are the hydrogen atom; R_4 is methyl, ethyl, *n*-propyl, *i*-propyl, or the hydrogen atom, and/or

* A is CR_6R_7, CR_8R_9; R_1, R_2 are selected from among methyl, ethyl groups or the hydrogen atom; R_3, R_5 to R_9, R_{12} are the hydrogen atom; R_4 is methyl, ethyl, *n*-propyl, *i*-propyl, or the hydrogen atom.

8 Process as in any one of Claims 1 to 7, characterized in that the triazole used is 2-(4-chlorobenzylidene)-5,5-dimethyl-1-(1H-1,2,4-triazol-1-ylmethyl)-1-cyclopentanol.

9 Agrochemical compositions intended:

* to improve the health of the plants, and/or
* to contribute to plant stem shortening, and/or
* to promote their resistance to lodging (even when eyespot disease is not present), and/or
* to increase nitrogen absorbed by the plants from the soil, and/or
* to reduce the amount of nitrogen that must be applied to the crop as fertilizer or manure, characterized in that they contain an effective amount of triazole as defined in any one of Claims 1 or 6 or 7 or 8.

10 Compositions as in Claim 9, characterized in that they contain 0.5% to 95% triazole.

11 Plant reproductive materials, characterized in that they are able to generate plants that:

* have improved health, and/or
* have a shortened stem under certain conditions, and/or
* have improved resistance to lodging (even when eyespot disease is not present), and/or
* have increased nitrogen absorbed by the plants from the soil, and/or
* require less nitrogen that must be applied to the crop as fertilizer or manure

and that they are treated with an effective amount of triazole such as defined in any one of Claims 1 or 6 or 7 or 8.

12 Materials as in Claim 11, characterized in that the reproductive material is in the form of grain or seed.

13 Use of a triazole of formula (I) such as defined in any one of Claims 1, 7, or 8 to make agrochemical compositions intended:

* to improve the health of the plants, and/or
* to contribute to plant stem shortening, and/or
* to promote their resistance to lodging (even when eyespot disease is not present), and/or
* to increase nitrogen absorbed by the plants from the soil, and/or
* to decrease the amount of nitrogen that must be applied to the crop as fertilizer or manure.

14 Use of a triazole of formula (I) as in Claim 13, characterized in that the agrochemical compositions contain 0.5% to 95% triazole.

15 Use of a triazole of formula (I) such as defined in any one of Claims 1, 7, or 8 to obtain plant reproductive materials [12] capable of generating plants that:

* have improved health, and/or
* have a shortened stem under certain conditions, and/or
* have improved resistance to lodging (even when eyespot disease is not present), and/or

* have increased nitrogen absorbed by the plants from the soil, and/or
* require less nitrogen that must be applied to the crop as fertilizer or manure.

16 Use of a triazole of formula (I) as in Claim 15, characterized in that the reproductive materials are in the form of grain or seed.

[logo] European Patent Office

EUROPEAN SEARCH REPORT

Application No.

EP 94 42 0127

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document, with indication, where necessary, of relevant portions	Relevant claim	CLASSIFICATION OF APPLICATION (Int.Cl.5)
X	EP-A-0 433 780 (BASF) *claims 7, 8 * * page 99, line 29 - page 100, line 31 * ---	1-7, 9-15	A01N43/653
X D	FR-A-2 662 911 (RHONE POULENC AGROCHEMIE) * claims 6, 7, 12 * & EP-A-0 467 791 (ID) ---	9-15	
X	EP-A-0 378 953 (RHONE-POULENC AGROCHEMIE) * claims 18-24 * ---	9-15	
A	EP-A-0 267 778 (KUREHA) * claim 8 * * page 37, line 30 - line 60 * * example 27 * ---	1-8	
			TECHNICAL FIELDS OF SEARCH (Int. Cl.5)
			A01N

This report was prepared for all the claims

Place of search	**Date search completed**	**Examiner**
LA HAYE	10 August 1994	Decorte, D.

CATEGORY OF THE CITED DOCUMENTS

X: of particular relevance when taken alone
Y: of particular relevance combined with another document in the same category
A: defines state of the art
O: nonwritten disclosure
P: intermediate document

T: theory or principle underlying the invention
E: patent document of date prior to filing date but published on or after this filing date
D: cited in the claim
L: cited for other reasons

&: member of the same family, corresponding document

[vertical in left margin] EPO FORM 1503 03.82 (P04C02)

[1] Translator's Note: Here, "graines" (often used the same way as "seeds" in English) is translated as "seed grains" for clarity when necessary or else just "grains," and the more general term "semences" is translated as "seeds" or "seed".
[2] Translator's Note: Corrected misplaced paragraphing/tab (should be a continuous line).
[3] Translator's Note: Corrected misplaced paragraphing/tab (should be a continuous line).
[4] Translator's Note: Probably the French "que" is a misprint for "ainsi que" ("as well as").
[5] Translator's Note: Corrected subscripts here and elsewhere: C1-C4 should be C_1-C_4.
[6] Translator's Note: They most likely mean the metric quintal = 100 kg as defined currently in France and not the North American quintal = hundredweight = 100 lb (the quintal is defined differently in different countries).
[7] Translator's Note: Corrected unnecessary unmatched right parenthesis.
[8] Translator's Note: Corrected misplaced paragraphing/tab (should be a continuous line).
[9] Translator's Note: Corrected misplaced paragraphing/tab (should be a continuous line).
[10] Translator's Note: Corrected misplaced paragraphing/tab (should be a continuous line).
[11] Translator's Note: Corrected repetition: French "en ce que en ce que" should be "en ce que" ("in that").
[12] Translator's Note: Corrected redundant repetition: French "de de" should be "de" ["of"].

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CERTIFICATION

International Language Center hereby certifies that the translation of the below-captioned document(s) from French into English is complete and accurate, to the best knowledge and ability of the undersigned, and that the entire translated documents have been reviewed for the purpose of assuring that the provisions contained therein convey the same meaning and value and have the same legal effect as the corresponding provisions in the original version of the document.

- ***Process for improving vigor and/or health of plants such as cereals by treatment with a triazole derivative***

Arturo Brunetti, Chairman